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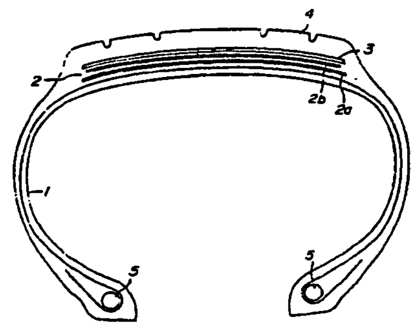
(54) PNEUMATIC RADIAL TIRE.

(57) The invention relates to a pneumatic radial tire wherein a belt consists of at least two layers of belt ply layers formed by arranging parallel metallic single wire cords having a filament diameter of 0.28 to 0.70mm at a cord angle of 15 to 30° to the equatorial plane of the tire with an end count of 30 to 120 per 50mm.and a rubber reinforcing layer which has a 25% modulus of 20 to 80 kg cm⁻² and which is at least 1 mm thick is disposed substantially adjacent to this belt ply layer. This tire has improved performances such as kinematic characteristics and rolling resistance and fatigue resistance of the cords. Since the single wire cord can be applied to the belt layer. the production cost is lower than that of the conventional tires.

EP 0 414 892 A1

FIG.1



PNEUMATIC RADIAL TIRES

Technical Field

This invention relates to a pneumatic radial tire using metallic cords coated with an elastomer as a belt layer, and more particularly it is to improve the durability without sacrificing the rolling resistance and running performances by avoiding cord breakage in the belt ply layer.

Background Art

In the radial tire, a twisted cord obtained by twisting 4 or 5 filaments each having a diameter of about 0.20 mm ~ 0.30 mm and represented by 1x4 or 1x5, a twisted cord obtained by twisting 7 filaments around 2 filaments and represented by 2+7, and the like are used in the belt ply layer. The tires using such cords had substantially satisfactory running performances, durability and rolling resistance.

Recently, with the advance of higher performances in passenger cars and the like, it is required that the tire to be mounted onto the vehicle is provided with higher improved performances, i.e. the running performances are high and the rolling resistance contributing to low fuel consumption and the like.

In Japanese Patent laid open No. 57-198101, there is described such a tire that a distance between centers of cords in two belt layers in radial direction of the tire when using the twisted cord or a single steel wire cord (hereinafter referred to as a single filament cord) in the belt ply layer does not exceed 1.0 mm and further an end count per 10 cm is not less than 60 cords. In this tire, it is attempted to ensure good rolling resistance by restraining the distance between cord centers in the belt ply layers to not more than 1.0 mm to reduce the volume of rubber coating the cord and hence decrease the energy loss through rubber by the reduced volume.

In this article, there are described an example of decreasing the twisting number in the metal cord to 5, 4, and 3, and an example of using a single filament as a cord. According to the inventors' studies, it has been confirmed that as the twisting number is decreased, energy loss of rubber penetrated into the inside of the cord and energy loss between the cords are reduced to obtain a very good rolling resistance, and further in case of using the single filament cord, the energy loss of rubber penetrated into the cord and the energy loss between the cords can considerably be reduced as compared with the case of using the twisted cord to obtain the better rolling resistance and consequently the belt structure using such cords is suitable for satisfying the high performances of the tire. Besides, there is known a passenger car tires having belt ply layers each obtained by embedding many single steel filament cords in rubber (Japanese Utility Model laid open No. 63-19404).

In the tires provided with belt layers of the single filament cords having good rolling resistance, however, the cord is apt to be fatigued, and there is remaining a problem that the cord breakage is frequently caused when performing, for example, a fatigue test of cord during rapid cornering, which is called as a so-called eight shape slalom test.

According to this test, the cord breakage becomes easy as the twisting number in the twisted cord decreases or in case of the single filament cord as compared with the twisted cord, so that the durability of the cord against fatigue (hereinafter referred to as a fatigue resistance) is conflicting with the objective running performances and rolling resistance. As a means for improving the fatigue resistance of cords, it is considered to increase the rubber gauge between the cords or the end count of cords, and the like. At first, the increase of rubber gauge between the cords fairly restrains the cord breakage, but results in the degradation of the rolling resistance. While, the increase of the end count can reduce a force applied to the cord to restrain the cord breakage, but increases the weight to injury the rolling resistance.

Alternatively, there are considered a technique in which a peculiar breaker structure reinforced with cords composed of high elasticity and substantially inextensible rubber material is disposed between carcass and tread in the tire (Japanese Patent laid open No. 62-289404), a technique in which a rubber sheet layer containing short fibers extremely oriented in the circumferential direction of the tire is arranged between end portion of belt and tread or between the belt layers in the belt (Japanese Patent laid open Nos. 61-119405 and 61-119407) and the like. However, it can not be said that these techniques are still sufficient in the prevention of cord breakage.

It is, therefore an object of the invention to propose a tire structure capable of simultaneously improving the running performances, the rolling resistance and the fatigue resistance of cords.

Disclosure of Invention

It is known that the cord breakage phenomenon by the eight shape slalom test is caused due to buckling deformation of a treading portion constituted with tire case, belt and tread during the running of the tire under loading. A critical compression force $N_{critical}$ of the belt beginning the occurrence of buckling deformation can be represented by the following equation when a compressive spring constant of tread is k and a bending rigidity of belt is D:

$$N_{critical} \propto \sqrt{kD}$$

As seen from the above equation, it is necessary to make the compressive spring constant k of the tread or the bending rigidity D of the belt large in order to increase the critical compression force in the occurrence of buckling deformation for suppressing the cord breakage. If the properties of tread rubber are changed in a direction increasing the tread compressive spring constant k, the running performances of the tire such as steering stability on dry and wet roads, ride comfortability against vibrations and the like naturally required in the tread rubber are degraded.

On the other hand, the freedom degree of the changing in the non-twisted single filament cord is restricted for increasing the belt bending rigidity D, so that such an object can be achieved only by increasing the cord diameter. However, in the passenger car tires, the ride comfortability against vibrations considerably degrades when the filament diameter of the single filament cord is increased, so that the increase of filament diameter is not convenient.

Now, it has been examined with respect to a means for avoiding cord breakage under a large input force and belt end separation on general running road by adding a third constituent in addition to the tread rubber and the single filament cord.

That is, various experiments were made with respect to tires having a belt bending rigidity D enhanced by arranging a reinforcing layer at a widthwise portion of tread outside the belt portion causing the occurrence of buckling deformation on cord breakage in the radial direction of tire over full periphery of tire, and as a result, it has been found that the fatigue resistance of the cord is improved and the running performances and rolling resistance are good without causing belt end separation during general running, and the invention has been accomplished.

That is, the invention is concerned with a pneumatic radial tire comprising a radial carcass ply, a tread arranged outside a crown region of the carcass in radial direction, and a belt disposed between the tread and the crown region of the carcass, characterized in that the belt is comprised of at least two belt ply layers each containing single metal filament cords of 0.28~0.70 mm in filament diameter arranged in parallel to each other and at a cord angle of 15~30° with respect to an equatorial plane of the tire and having an end count of 30~120 cords per 50 mm, and a rubber reinforcing layer having a 25% modulus of 20~80 kg/cm² and a thickness of not less than 1 mm is arranged substantially adjacent to the belt ply layer

Brief Description of Drawings

Fig. 1 is a sectional view of a pneumatic radial tire according to the invention: and

Figs. 2~4 are sectional views of another structures.

Best Mode of Carrying out the Invention

In the pneumatic radial tires shown in Figs. 1~4, 1 is a carcass, 2 a belt ply layer, 3 a rubber reinforcing layer, 4 a tread and 5 a bead core. The belt ply layer 2 is comprised of a ply obtained by arranging single filament cords of 0.28~0.70 mm in filament diameter at 15~30° with respect to the equatorial plane of the tire and at an end count of 30~120 cords per 50 mm. In the illustrated embodiments, the belt has a two layer structure of first belt ply layer 2a and second belt ply layer 2b. When the single filament cord in the belt ply layer is arranged at an angle of less than 15° with respect to the equatorial plane of the tire, the bending rigidity in radial direction of the belt undesirably lowers, while when it exceeds 30°, the rigidity in circumferential direction of the belt undesirably lowers.

In the pneumatic radial tire shown in Fig. 1, the rubber reinforcing layer 3 is arranged between the tread 4 and the belt ply layer 2. Preferably, the rubber reinforcing layer 3 is extended from an end portion of an

outermost layer in the radial direction of the tire among the belt ply layers 2 to the other end portion thereof as illustrated.

In the pneumatic radial tire shown in Fig. 2, the rubber reinforcing layer 3 is divided into two parts, each of which parts is arranged to extend from a point corresponding to 1/4 of a full width of an outermost layer among the belt ply layers 2 in the radial direction of the tire to the end portion of the outermost layer of the belt ply layers 2 in the radial direction of the tire.

In the pneumatic radial tire shown in Fig. 3, the rubber reinforcing layer 3 is arranged between the belt ply layers 2. Moreover, when the belt ply layers 2 are 3 or more, it is preferable that the rubber reinforcing layer 3 is adjacent to an outermost layer among the belt ply layers 2 in the radial direction of the tire inside the outermost layer in the radial direction of the tire and extended from an end portion of the outermost layer in the radial direction of the tire to the other end portion thereof.

In the pneumatic radial tire shown in Fig. 4, the rubber reinforcing layer 3 is arranged between the belt ply layer 2 and the crown region of the carcass 1. Preferably, the rubber reinforcing layer 3 is adjacent to an innermost layer among the belt ply layers 2 in the radial direction of the tire inside the innermost layer in the radial direction of the tire and extended from an end portion of the innermost layer of the belt ply layers 2 in the radial direction of the tire to the other end portion thereof.

Moreover, 25% modulus of the rubber reinforcing layer 3 is preferably 40~70 kg/cm^2. The 25% modulus according to the invention means a modulus when a tensile test is carried out in the radial direction of the tire.

In the belt ply layer of the tire, the cord is apt to be broken as the twisting number becomes small, and the breakage is most caused in the single filament cord. However, even in tires using the single filament cords in the belt ply layer, when the rubber reinforcing layer is applied to the belt ply layer over at least a distance from a mid-point between center of ground contact width of the tread and ground contact end to the end of the belt layer, the fatigue resistance of the cord can be improved.

Particularly, in case of the fine single filament cord of not more than 0.35 mm in filament diameter, the belt bending rigidity can not be made high as compared with that of the usual twisted cord, so that the resistances to belt breakage and belt end separation are poorer than those of the conventional twisted cord. However, such a drawback can be overcome by the use of the rubber reinforcing layer, and also it is possible to ensure the resistance level higher than the conventional one when the filament diameter becomes 0.28 mm. Thus, the tires having the rubber reinforcing layer and using the single filament cord exhibit good running performances and are small in the rolling resistance.

The reason why the filament diameter of the single filament cord is limited to a range of 0.28~0.70 mm is due to the fact that when it is less than 0.28 mm, the belt folding property and resistance to belt end separation are poor and the end count increases to degrade the operability, while when it exceeds 0.70 mm, the ride comfortability against vibrations largely degrades. Further, it is desirably within a range of 0.30~0.40 mm.

The reason why the end count of the single filament cord per 50 mm is limited to 30~120 cords is due to the fact that when it is less than 30 cords, the belt rigidity can not sufficiently be ensured and also the shearing strain between the belt layers becomes large to cause the belt folding or the belt end separation, while when it exceeds 120 cords, the actual production is difficult because of excessive end count. Preferably, it is within a range of 35~80 cords.

Moreover, high carbon steel having a C content of 0.80~0.90 wt% is advantageously suitable as a material for the single filament cord.

Further, the cord distance between the adjoining belt layers, i.e. minimum distance between outer peripheries of the cords (coating rubber gauge between the single filament cords) is not less than 0.8 mm, preferably not less than 1.0 mm from a viewpoint of the enhancement of resistance to belt end separation and fatigue resistance of cord through the rubber reinforcing layer.

Then, the rubber reinforcing layer itself will be described in detail.

As a means for effectively enhancing the bending rigidity in radial direction, there are the use of hard rubber stock as a base rubber and the optimization of its arrangement. As the other means, there are optimized the materials of tread rubber, belt coating rubber, layer cap member and ply as well as the used number thereof. However, the inventors could confirm that the increase of modulus in the base rubber and the optimization of base rubber arrangement are effective for satisfying the resistance to cord breakage while avoiding bad influence upon the running performances and the rolling resistance. Although the same improving effect on cord breakage as in the increase of modulus of the base rubber is obtained even by the improvement of layer cap member, the use of the layer cap member degrades the uniformity at joint portion and is disadvantageous in the cost. On the contrary, when the bending rigidity in radial direction is achieved by using the hard rubber stock as a base rubber, there are large merits that the joint portion is absent and

loss level of rubber is controlled, and consequently the uniformity level is good and the level of the rolling resistance can freely be controlled.

The inventors have made various examinations with respect to the use of hard rubber stock as a base rubber and the arrangement thereof, and found the following facts.

Firstly, when the hard rubber stock is used as a base rubber (belt reinforcing layer) in the usual tread structure (inner liner + one carcass ply + two belt ply layers + tread rubber), the modulus of this rubber stock is variously changed. As a result, it has been found that when 25% modulus is not less than 20 kg/cm^2, the cord breakage through the eight shape slalom test can be controlled. Further, when the single filament wire is applied to the usual tread structure and the hard rubber stock is arranged as a base rubber outside the wire in the radial direction of the tire, if the 25% modulus is not less than 20 kg/cm^2, there is no problem on the resistance to cord breakage, and also the running performances and the rolling resistance are held satisfactorily. Moreover, when the 25% modulus is not less than 40 kg/cm^2, the resistance to cord breakage, running performances and rolling resistance are further improved, and preferably it is possible to thin the gauge of the base rubber.

On the other hand, when it exceeds 80 kg/cm^2, the rubber composition at unvulcanized state becomes very hard, and the operability largely lowers to undesirably cause the considerable reduction of productivity.

The reason why the thickness of the rubber reinforcing layer according to the invention is limited to not less than 1 mm is due to the fact that when it is less than 1 mm, the improving effect of the fatigue resistance is not recognized. Moreover, the upper limit of the thickness is necessarily determined by the thickness of the tire product, so that it is not particularly necessary to set the upper limit, but it is preferably 5 mm. When it exceeds 5 mm, the heat build-up and high-speed durability of the tire lower. In the radial tires for passenger cars, the thickness of tire product is thin, so that the thickness of the rubber reinforcing layer is preferable to be not more than 4 mm.

As to the arrangement of the hard rubber stock, the inventors have made various examinations with respect to cases that the reinforcing layer of hard rubber stock is arranged between tread and belt, between belt ply layers and between belt and crown portion of carcass, and found that the improving effect on the resistance to cord breakage becomes particularly conspicuous when the reinforcing layer is arranged between the tread and the belt. This is considered due to the fact that the position of neutral axis of the composite body existing when the bending input is applied approaches to the cords of the innermost belt ply layer in the radial direction causing the cord breakage, and consequently the cord breakage is hardly caused.

As mentioned above, it is ideal that the reinforcing layer of hard rubber stock is arranged between the tread and the belt in the tire, i.e. outside the belt ply layer in the radial direction of the tire from a viewpoint of the resistance to cord breakage, but even when it is arranged between the belt ply layers or between the belt and the carcass, the cord breakage can be sufficiently be prevented and the running performances and rolling resistance can be made good by properly regulating the modulus of the hard rubber stock. The merit inherent to these arrangements lies in a point that when the rubber reinforcing layer is arranged between the tread and the belt, it is required to arrange the hard rubber stock so as not to expose if the tread wearing completely proceeds, but when it is arranged inside the belt ply layer in the radial direction of the tire, there is not caused the above anxiety.

The invention will be described with reference to the following example.

Various radial tires having a tire size of 165 SR13 were manufactured according to dimension and size as shown in the following Table 1, and then the fatigue resistance of cords, resistance to belt end separation, indoor steering property and rolling resistance were evaluated with respect to these tires. The measured results are also shown in Table 1. The compounding example of rubber layer used as the reinforcing layer of the tire in the same Table was according to the following Table 2 (part by weight).

Table 1(a)

Tire No.		1	2	3	4	5
		Example 1	Example 2	Example 3	Comparative Example 1	Comparative Example 2
Design factors	Kind of belt cord (filament diameter)	single filament cord (0.50 mm)	single filament cord (0.50 mm)	single filament cord (0.50 mm)	single filament cord (0.50 mm)	1×5×0.23
	End count (/50 mm)	48	48	48	48	38
	Cord angle of belt	68	68	68	68	68
	Belt coating gauge (mm)	0.50	0.50	0.50	0.50	0.50
	Rubber reinforcing layer *1 25% modulus (kg/cm^2)	65	40	20	10	10
	Arrangement of rubber reinforcing layer applied (Figs. 1-4) (thickness: mm)	Fig. 1 (1.5)	Fig. 1 (1.5)	Fig. 1 (1.5)	Fig. 1 (1.5)	Fig. 1 (1.5)
	Compounding example (in Table 2)	Compounding Example 1	Compounding Example 2	Compounding Example 3	Compounding Example 4	Compounding Example 4
Evaluation results	Resistance to cord breakage *2	0	0	38	43	0
	Indoor steering property *3	104	104	103	102	100
	Rolling resistance *4	104	106	110	105	100
	Resistance to belt end separation (mm) *5	1.5	2.0	2.5	3.0	8.0

Table 1(b)

		6	7	8	9	10	11
Tire No.		6	7	8	9	10	11
		Example 4	Example 5	Example 6	Example 7	Comparative Example 3	Example 8
Design factors	Kind of belt cord (filament diameter)	single filament cord (0.50 mm)	single filament cord (0.50 mm)	single filament cord (0.50 mm)	single filament cord (0.50 mm)	1×5×0.23	single filament cord (0.50 mm)
	End count(/50 mm)	48	48	48	48	38	48
	Cord angle of belt	68	64	68	68	68	68
	Belt coating gauge (mm)	0.50	0.50	0.50	0.50	0.50	0.50
	Rubber reinforcing layer 25% modulus *1 (kg/cm^2)	65	65	65	65	10	65
	Arrangement of rubber reinforcing layer applied (Figs. 1-4) (thickness: mm)	Fig. 1 (1.5)	Fig. 1 (1.5)	Fig. 4 (1.5)	Fig. 3 (1.5)	Fig. 1 (1.5)	Fig. 2 (1.5)
	Compounding example (in Table 2)	Compounding Example 1	Compounding Example 1	Compounding Example 1	Compounding Example 1	Compounding Example 4	Compounding Example 1
Evaluation results	Resistance to cord breakage *2	0	0	10	5	0	4
	Indoor steering property *3	104	103	102	103	100	102
	Rolling resistance *4	104	104	104	104	100	104
	Resistance to belt end separation (mm) *5	1.5	1.0	2.0	0	8.0	2.0

*1 ... measured according to JIS K6301 (tensile testing method). In this case, the tensile speed was 100 mm/min, and the test specimen of Dumbbell shape was subjected to a tensile test in the radial direction of the tire to measure the modulus in the radial direction of the tire. The shape of Dumbbell test specimen was adjusted to be larger and thicker as far as the available sample shape was permitted.

*2 ... eight shape slalom test, i.e. the tire was rapidly turned on a rhem skating curve by using a rhem skating automatic running device, and after the repetition of this procedure 300 lap times, the tire was cut to measure the number of broken cords in the belt layer. 0 shows no breakage of belt cord.

*3 ... when the tire itself was rotated on a rotating drum according to JIS D4202, the cornering force, self-aligning torque and camber thrust were measured. The indoor steering property was totally evaluated from these values and represented by an index on the basis that tire No. 13 was 100. The larger the numerical value, the better the property.

*4 ... slalom test results on a drum according to JIS D4202, 4203 and 6401 were represented by an index on the basis that tire No. 13 was 100. The larger the numerical value, the smaller the rolling resistance.

*5 ... after general running test, i.e. the tire was mounted on a taxing car and run over a distance of 60,000 km, the crack length produced inside the belt layer was measured within an accuracy of ±0.5 mm, and the measured value was shown on average. 0 shows no crack.

Table 2

	Compounding example 1	Compounding example 2	Compounding example 3	Compounding example 4
Natural rubber	100	100	100	70
SBR 1500 *1	-	-	-	30
Carbon black HAF *2	70	70	-	30
Carbon black FEF *3	-	-	42	-
Stearic acid	2	2	2	2
Process oil	-	-	-	6
Zinc white	7.5	7.5	5	2.5
Antioxidant *4	-	-	1	1
Vulcanization accelerator *5	1.5	1.5	1.8	0.6
Sulfur	4	4	7	2.75
Arunopol PN 844 *6	20	10	-	-
Hexamethylene tetramine	2.0	1	0.5	-
Resorcin	-	-	1.0	-
Low loss agent *7	-	-	2.0	-
Elongation at break (%)	220	207	130	490
25% Modulus (kg/cm^2)	65	40	20	10
Resilience	43	47	85	76

*1 ... made by Japan Synthetic Rubber Co., Ltd., styrene-butadiene rubber
*2 ... IA 86 mg/g, DBP 102 cm^3/100 g
*3 ... IA 43 mg/g, DBP 121 cm^3/100 g
*4 ... 2,2'-methylene bis(4-methyl-6-tert-butyl phenyl)
*5 ... N-oxydiethylene-2-benzothiazyl sulfeneamide
*6 ... alkylphenol novolak resin, trade name of Hoechst
*7 ... paranitroso diphenyl amine

From Table 1, it is understood that tire Nos. 1~3, 6~9 and 11 according to the invention using the single filament cord in a belt layer and arranging the rubber reinforcing layer show good results on all items.

On the other hand, in then tires using the 1x5 twisted cord in the belt layer and adding low modulus reinforcing layer (tire Nos. 5, 10), the fatigue resistance of cord, rolling resistance and indoor steering property can be maintained, but the resistance to belt end separation is fairly poor as compared with the radial tires according to the invention.

Further, when the 25% modulus of the rubber reinforcing layer is made low as in tire No. 4, the resistance to belt end separation is poor and the fatigue resistance of cord largely lowers, so that it is difficult to simultaneously establish the durability and the running performances.

Industrial Applicability

In the pneumatic radial tire according to the invention, the simultaneous establishment between the running performances and the durability can be achieved in a high dimension. Further, the single filament cord can be applied to the belt layer, so that the twisting step for the cord is useless and the tire can cheaply be provided as compared with the conventional tire.

Claims

1. A pneumatic radial tire comprising a radial carcass ply, a tread arranged outside a crown region of the carcass in radial direction, and a belt disposed between the tread and the crown region of the carcass, characterized in that the belt is comprised of at least two belt ply layers each containing single metal filament cords of 0.28~0.70 mm in filament diameter arranged in parallel to each other and at a cord angle of 15~30° with respect to an equatorial plane of the tire and having an end count of 30~120 cords per 50 mm, and a rubber reinforcing layer having a 25% modulus of 20~80 kg/cm^2 and a thickness of not less than 1 mm is arranged substantially adjacent to the belt ply layer.

2. The pneumatic radial tire according to claim 1, wherein said rubber reinforcing layer is arranged between said tread and said belt.

3. The pneumatic radial tire according to claim 1, wherein said rubber reinforcing layer is arranged between said belt ply layers.

4. The pneumatic radial tire according to claim 1, wherein said rubber reinforcing layer is arranged between said belt and said crown region of said carcass.

5. The pneumatic radial tire according to claim 2, wherein said rubber reinforcing layer extends from an end portion of an outermost layer among said belt ply layers in the radial direction of the tire to the other end portion thereof.

6. The pneumatic radial tire according to claim 2, wherein said rubber reinforcing layer is divided into two parts, each of which parts is arranged to extend from a point corresponding to 1/4 of a full width of an outermost layer among said belt ply layers in the radial direction of the tire to the end portion of said outermost layer in the radial direction of the tire.

7. The pneumatic radial tire according to claim 3, wherein said rubber reinforcing layer is adjacent to an outermost layer among said belt ply layers in the radial direction of the tire inside said outermost layer in the radial direction of the tire and extended from an end portion of said outermost layer among said belt ply layers in the radial direction of the tire to the other end portion thereof.

8. The pneumatic radial tire according to claim 4, wherein said rubber reinforcing layer is adjacent to an innermost layer among said belt ply layers in the radial direction of the tire inside said innermost layer in the radial direction of the tire and extended from an end portion of said innermost layer among said belt ply layers in the radial direction of the tire to the other end portion thereof.

9. The pneumatic radial tire according to any one of claims 2~4, wherein said rubber reinforcing layer has a 25% modulus of 40~70 kg/cm^2.

FIG. 1

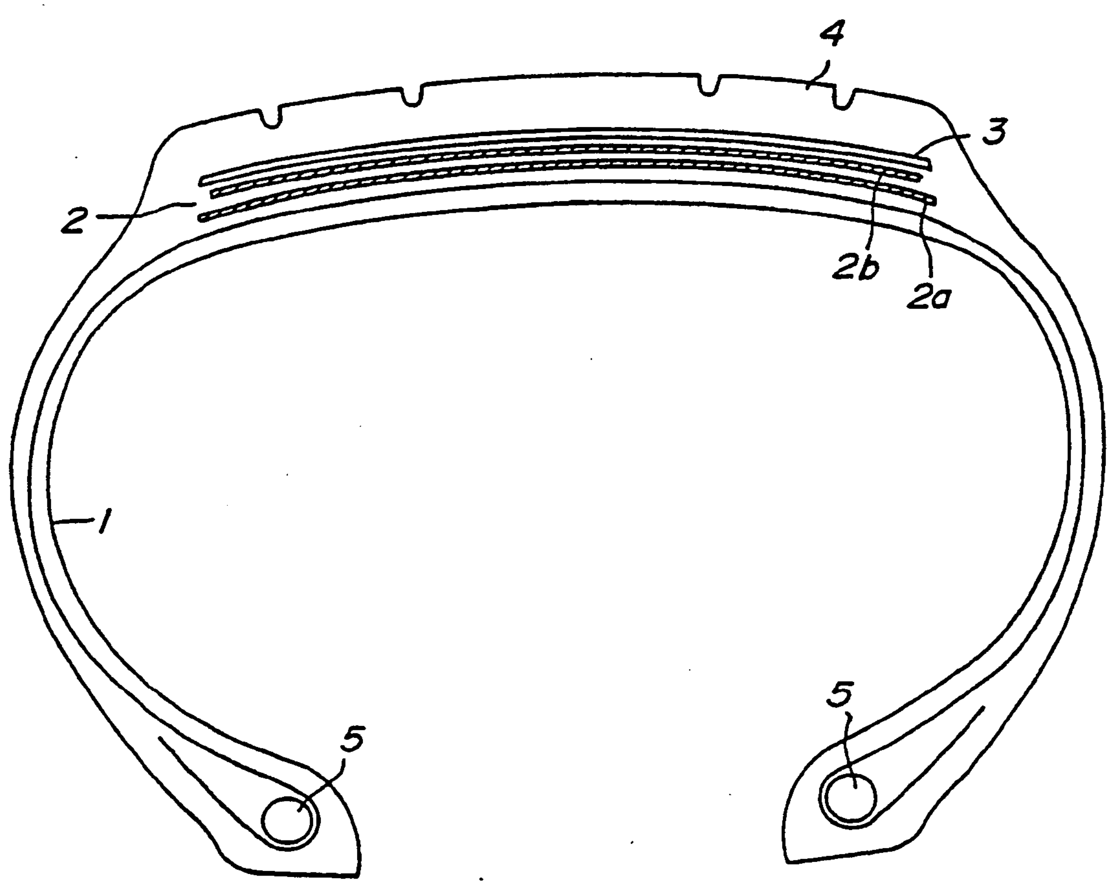


FIG.2

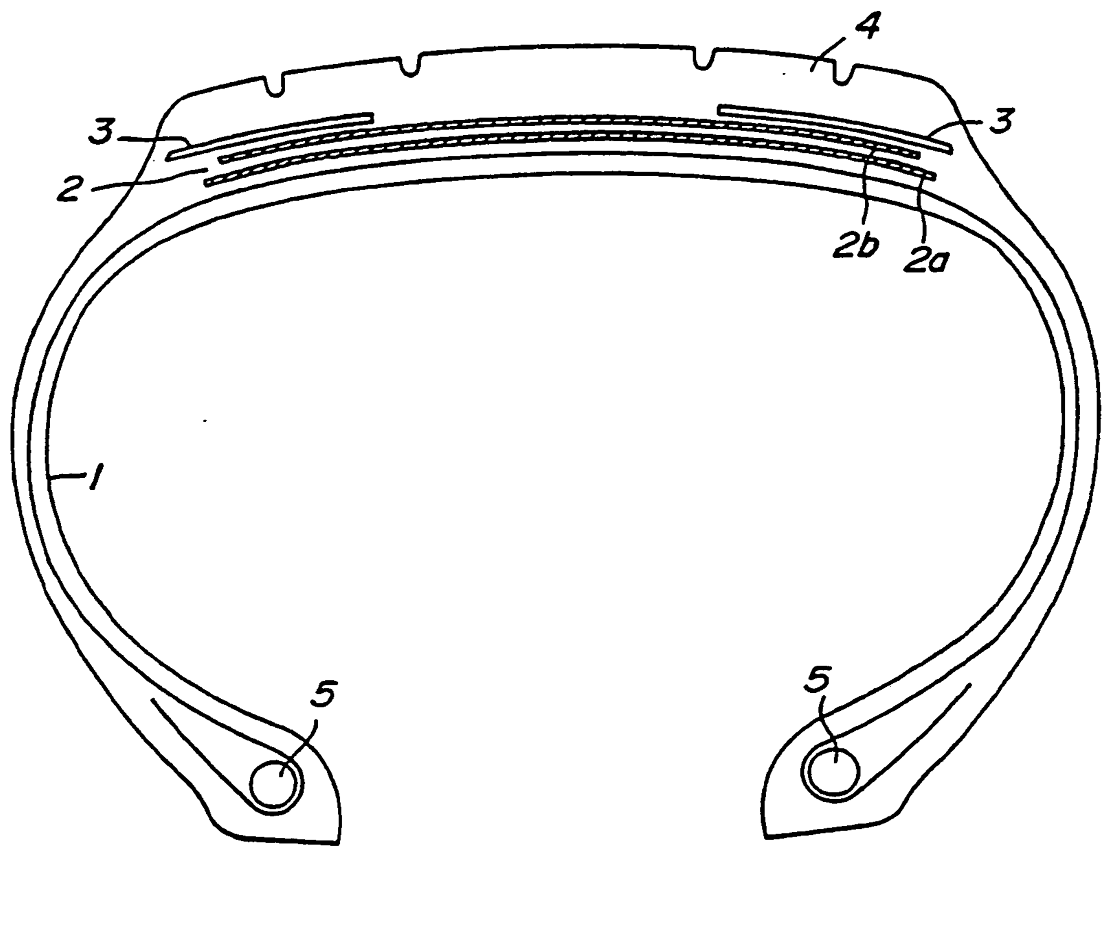


FIG_3

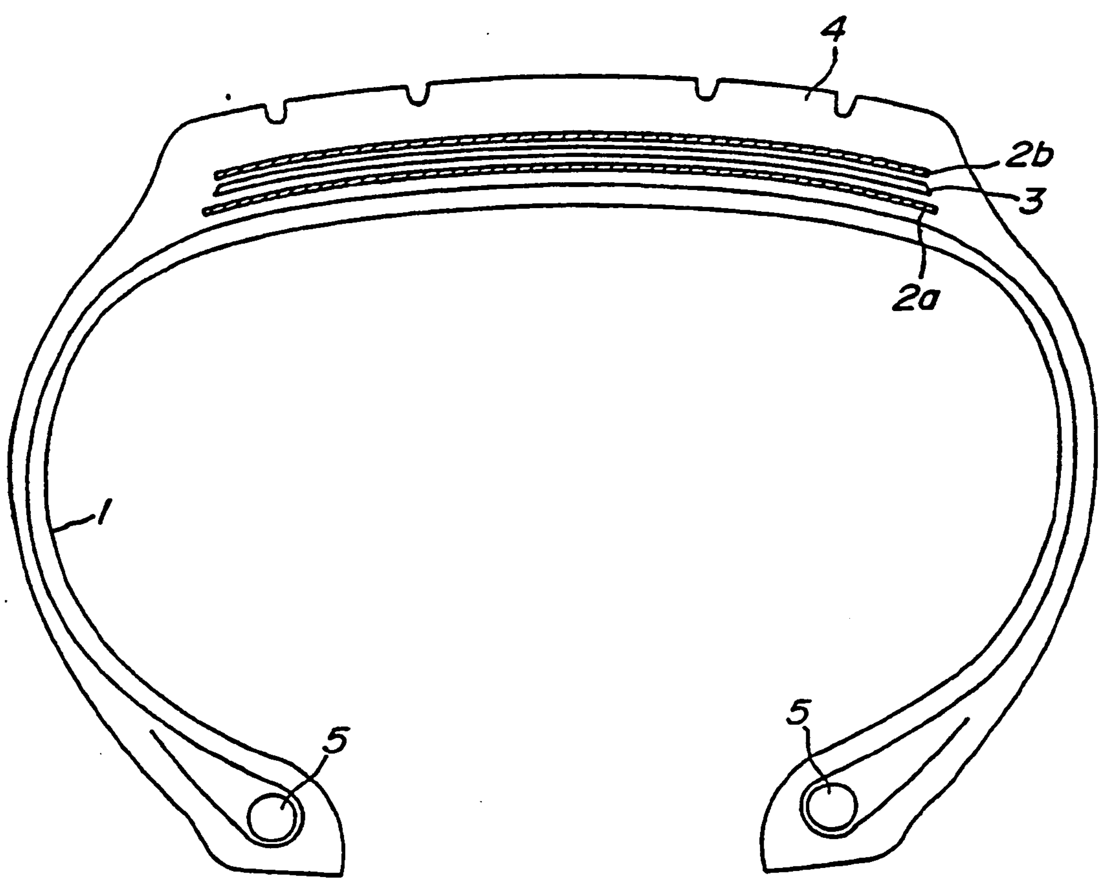
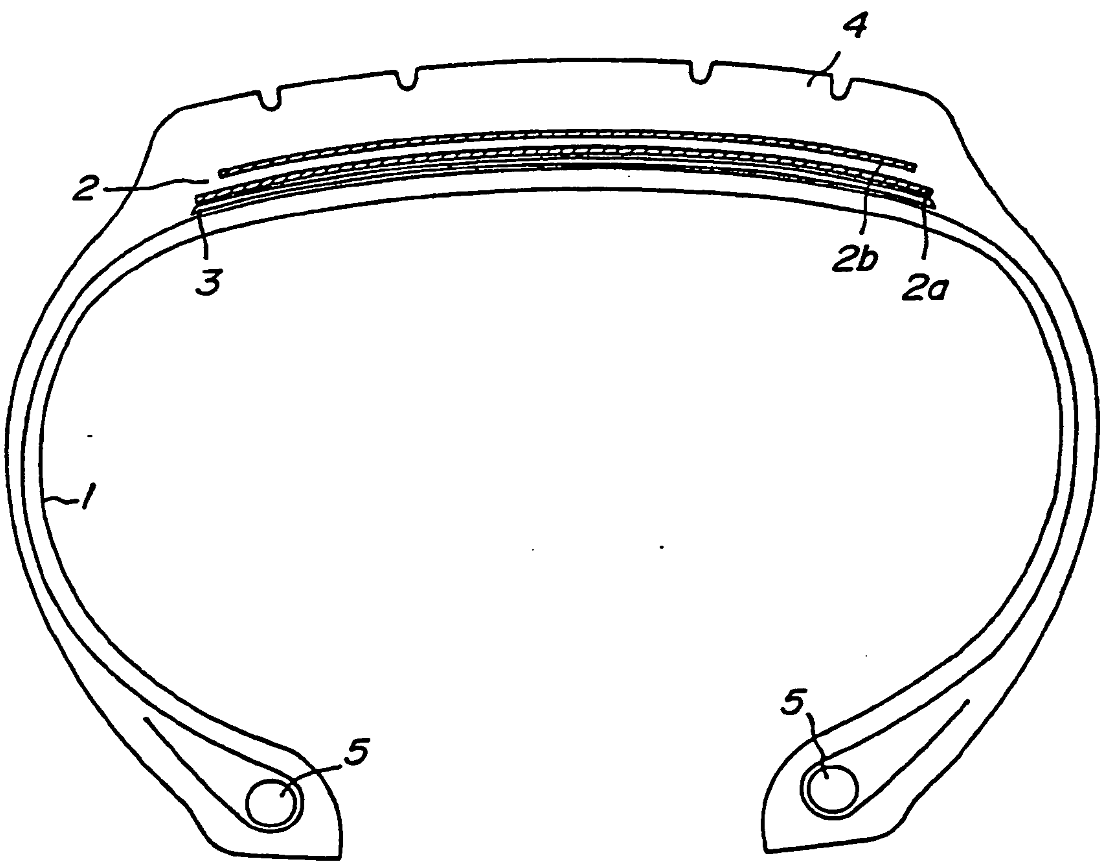


FIG.4



INTERNATIONAL SEARCH REPORT

International Application No PCT/JP89/00251

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl[4] B60C9/20

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC	B60C9/18-9/30

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

Jitsuyo Shinan Koho	1926 - 1989
Kokai Jitsuyo Shinan Koho	1971 - 1989

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
A	JP, A, 57-198101 (Societa Pneumatici Pirelli S.p.A.) 4 December 1982 (04. 12. 82) Page 1, lower left column, line 14 to lower right column, line 3, page 2, lower right column, lines 4 to 9 & DE, Ul, 8126827	1
A	JP, U, 63-19404 (Bridgestone Corporation) 8 February 1988 (08. 02. 88) Scope of Claim for Utility Model Registration (Family: none)	1
A	JP, A, 61-12989 (The Goodyear Tire & Rubber Co.) 21 January 1986 (21. 01. 86) Page 2, lower left column, lines 10 to 13, line 18 to lower right column, lines 1, 4 to 5 (Family: none)	

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
June 1, 1989 (01. 06. 89)	June 12, 1989 (12. 06. 89)

International Searching Authority	Signature of Authorized Officer
Japanese Patent Office	

Form PCT ISA 210 (second sheet) (January 1985)

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

A	JP, A, 62-289404 (The Firestone Tire & Rubber Co.) 16 December 1987 (16. 12. 87) Page 1, lower left column, lines 5 to 10 (Family: none)	1
A	JP, A, 61-119405 (Bridgestone Corporation) 6 June 1986 (06. 06. 86) Page 1, lower left column, line 13 to lower right column, line 1 (Family: none)	1, 3, 5, 7

V.☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [1]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons

1.☐ Claim numbers . . because they relate to subject matter not required to be searched by this Authority, namely

2.☐ Claim numbers , because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically.

3.☐ Claim numbers , because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a)

VI.☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [2]

This International Searching Authority found multiple inventions in this international application as follows.

1.☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2.☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3.☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4.☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees

International Application No. PCT/JP89/00251

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

A	JP, A, 61-119407 (Bridgestone Corporation) 6 June 1986 (06. 06. 86) Page 1, lower left column, line 12 to lower right column, line 1 (Family: none)	1, 2, 6

V.☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [1]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1.☐ Claim numbers , because they relate to subject matter not required to be searched by this Authority, namely:

2.☐ Claim numbers , because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3.☐ Claim numbers , because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI.☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [2]

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4.☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest

☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (supplemental sheet (2)) (January 1985)